EASTERN REGION TECHNICAL ATTACHMENT
NO. 94-2A
FEBRUARY, 1994

VERIFICATION OF CLOUD COVER FORECASTS IN THE EXTENDED FORECASTS OF WSFO INDIANAPOLIS AND WSFO WASHINGTON D.C.

Mark P. DeLisi
National Weather Service Forecast Office
Sterling, Virginia

1. INTRODUCTION

The National Weather Service (NWS) extended forecast product (EFP), now a part of the state forecast product (SFP), covers the 3 to 5 day period. There has been some debate about whether cloud cover forecasts should be part of the extended forecast product. The general purpose of this study was to assess the skill of cloud cover forecasts in the extended forecasts prepared at the Weather Service Forecast Offices at Indianapolis and Washington D.C. (WSFO IND and WSFO WBC, respectively).

2. DATA COLLECTION

At WSFO IND, forecasters were instructed to produce cloud cover forecasts for Indianapolis for each period of the extended forecast, from February 2 through April 1, 1990; September 23 through December 14, 1990; and April 28, 1991 through January 29, 1992. All months of the year were covered except for most of April, and there was duplication from late September through mid December. Forecasters were confined to the five sky condition categories: "clear;" "mostly clear;" "partly cloudy;" "mostly cloudy;" and "cloudy". The forecasts were made at approximately 3:00 p.m. EST based on extended guidance from the most recent run of the MRF (Medium Range Forecast) model, limited projections of the most recent runs of the ECMWF (forecast from the European Center for Medium Range Weather Forecasting) and UKMET (forecast from the United Kingdom Meteorological Office) models, and NMC (National Meteorological Center) man-machine system. Occasional updates were made at approximately 4:30 a.m. EST the following morning, but these were too few in number to be retained for verification. Forecasters occasionally neglected to make forecasts for some or all of the periods. Overall, there were 366 forecasts for period one (day three), 357 forecasts for period two (day four), and 356 forecasts for period three (day five).

Observations used for the verification process were from the hourly record surface aviation observations taken at WSFO IND. Mean hourly opaque sky cover for each 24-h day (midnight to midnight EST) was computed for all days during the period of study. NWS definitions for the five cloud cover categories (National Weather Service

1984) were the basis used to convert the mean hourly opaque sky covers to cloud cover categories for purposes of verification.

At WSFO WBC, forecasters were aware of the ongoing verification process, but they were not asked specifically to make cloud cover forecasts. They were not confined to the five categories, and were not asked to make forecasts for any specific location within the general forecast area. Rather, regularly produced extended forecasts were collected over the periods from January 10, 1991 through March 8, 1992; March 17 through April 5, 1992; and April 28 through July 29, 1992. All months of the year were covered, and there was duplication for much of the period from January through July. The forecasts were made at approximately 4:30 p.m. EST based on the same guidance as that used at WSFO IND.

WSFO WBC generated three different extended forecasts during the study. One was for Delaware; one was for Virginia; and one was for Maryland and the eastern panhandle of West Virginia. The Washington D.C. metropolitan area covers a part of northern Virginia and mid eastern Maryland, and WSMCO DCA (the contract meteorological observatory at Washington National Airport, which was where the verifying observations were taken) is in Virginia, across the Potomac River from downtown Washington D.C. However, through the period of study the office and local media used the Maryland extended forecast for the Washington D.C. metropolitan area, and forecasters generated the product with that in mind. The study therefore verified the Maryland extended forecast for Washington D.C. area against the WSMCO DCA observations.

Some of the collected forecasts from WSFO WBC did not contain specific cloud cover forecasts ("mainly dry" or "rain likely" are examples). To avoid inferring, sometimes incorrectly, what kind of cloud cover forecast was intended, these forecasts were not retained. Other forecasts contained cloud cover forecasts that could not be fit into the five categories ("variable cloudiness" or "fair" are examples). In order to support analysis similar to that of the WSFO IND data, these forecasts were not retained. Still other forecasts were such that one cloud cover forecast could not be assigned with certainty to a 24-h calendar day ("mostly cloudy Sunday...clearing Sunday night" is an example). These forecasts were not retained. Therefore, even though the period of study was longer for WSFO WBC than it was for WSFO IND, there were 336 forecasts for period one (day three), 339 forecasts for period two (day four), and 350 forecasts for period three (day five).

Updates were issued daily at WSFO WBC at approximately 5:00 a.m. EST. Forecasters almost always waited until new guidance was available. Whenever a routine update involved an updated cloud cover forecast and that forecast met the conditions described before, the forecast was retained for separate verification. There were 51 updates of the period one cloud cover forecast, 58 updates of the period two forecast, and 57 updates of the period three forecast retained.

As noted previously, observations used for the verification analysis were from the hourly record surface aviation observations taken at WSCMO DCA. As with the data from WSFO IND, mean hourly opaque sky cover for each 24-h EST day was computed for all days during the period of study. Again, the NWS definitions of the five cloud cover categories were used as a basis to convert the mean hourly opaque sky covers to cloud cover categories for purposes of verification.

3. DATA ANALYSIS

Chi-square analysis (Panofsky and Brier 1968) was used to verify the cloud cover forecasts made by WSFO IND and WSFO WBC with observations taken at WSFO IND and WSMCO DCA respectively. NWS definitions of the five cloud cover categories are not conducive to categorization of continuous data (National Weather Service 1984). Therefore, the NWS definitions were interpreted for purposes of this study in the following manner: clear or sunny (0 - < 1 tenth opaque sky cover); mostly clear or mostly sunny (1 - < 3 tenths opaque sky cover); partly cloudy or partly sunny (3 - < 6.5 tenths opaque sky cover); mostly cloudy or considerable cloudiness (6.5 - < 8.5 tenths opaque sky cover); and cloudy (8.5 - 10 tenths opaque sky cover).

The analysis tested the null hypothesis, for each WSFO and for each period of the extended forecast, that the forecasts were independent of the observations. This is equivalent to testing the assertion that the forecasts had no skill. Contingency tables for the forecasts and observations are given in Tables 1 through 6. Derived contingency tables based on the null hypothesis are not shown.

For WSFO IND, the resultant chi-square values (88.86 for period one, 65.84 for period two, and 44.90 for period three) allow the null hypothesis to be rejected, and therefore indicate skill, with a p-value of < .001 for each of the three periods. For WSFO WBC, the resultant chi-square values (69.02 for period one, 59.62 for period two, and 24.63 for period three) allow the null hypothesis to be rejected with a p-value of < .001 for periods one and two. The p-value associated with the chi square value for period three is slightly larger than .05. A conservative interpretation is that there is not significant evidence to reject the null hypothesis (indicate skill) for the period three cloud cover forecast at WSFO WBC.

In a less rigorous method to gauge the skill of the forecasts, the study determined for each WSFO, for each period, the percentage of reasonably accurate and inaccurate forecasts, and the ratio of reasonably accurate to inaccurate forecasts. Reasonably accurate forecasts were considered to be: forecasts of "clear" or "mostly clear" for days when it was either clear or mostly clear; forecasts of "partly cloudy" for days when it was partly cloudy; and forecasts of "mostly cloudy" or "cloudy" for days when it was either mostly cloudy or cloudy. Inaccurate forecasts were: forecasts of "clear" or "mostly clear" for days when it was mostly cloudy or cloudy; forecasts of "partly cloudy" when it was sunny or cloudy; and forecasts of "mostly cloudy" or "cloudy" when it was mostly sunny or sunny.

For WSFO IND, 48.6% of period one forecasts, 46.2% of period two forecasts, and 43.3% of period three forecasts were reasonably accurate. Additionally, 17.8% of period one forecasts, 22.4% of period two forecasts, and 23.9% of period three forecasts were inaccurate. Hence, the ratios of reasonably accurate to inaccurate forecasts were 2.74 for period one, 2.06 for period two, and 1.81 for period three.

For WSFO WBC, 50.3% of period one forecasts, 47.8% of period two forecasts, and 42.6% of period three forecasts were reasonably accurate. Additionally, 16.4% of period one forecasts, 18.9% of period two forecasts, and 22.3% of period three forecasts were inaccurate. Hence, the ratios of reasonably accurate to inaccurate forecasts were 3.07 for period one, 2.53 for period two, and 1.91 for period three.

Next, the study examined whether cloud cover forecasting skill was still present when the days were more independent of each other. One-day changes in average opaque sky cover were computed for each observation site and for both sites combined (see Table 7). Days from February 3, 1990 to April 1, 1990; September 23, 1990 to December 14, 1990; and February 28, 1991 to January 29, 1992 comprised the WSFO IND sample. All days from January 10, 1991 to July 29, 1992 made up the WSCMO DCA data. The purpose was to arrive at a threshold one-day change value that had to be equalled or exceeded before a day would be kept for the verification process. The rationale was that a fairly large one-day change in average opaque sky cover likely indicated a change in the weather pattern, and so keeping only observations from such days increased the independence of the data.

The threshold value was a one-day change of 4.5 tenths opaque sky cover. That value was based on visual inspection of the data and on the number of cases needed to make chi-square analysis meaningful. The chi square analysis was reduced from 16 to 4 degrees of freedom (from five cloud cover forecast/observation categories to three, namely "clear/mostly clear", "partly cloudy", and "mostly cloudy/cloudy") in order to use a fairly high threshold value. The threshold value of 4.5 resulted in 79% of the WSFO IND observation days and 83% of the WSCMO DCA observation days being thrown out. Ultimately, 68 period one forecasts, 74 period two forecasts, and 73 period three forecasts were retained from WSFO IND. From WSFO WBC, 52 period one forecasts, 48 period two forecasts, and 58 period three forecasts were retained.

For WSFO IND, the resultant chi-square values (2.922 for period one, 8.071 for period two, and 5.293 for period three) yielded p-values greater than 0.05 in all three cases. Likewise, the resultant chi-square values for WSFO WBC (1.902 for period one, 3.166 for period two, and 5.9 for period three) also produced p-values greater than 0.05 in all three cases. Associated contingency tables are given in Tables 8 through 13. Derived contingency tables based on the null hypothesis are not given. The null hypothesis of independence between forecasts and observations of only three cloud cover categories, and equivalently the absence of an indication of skill, cannot be rejected when independence is increased for either WSFO for any of the three periods.

Within the subset of forecasts for days that were more independent, the study again looked at the percentage of reasonably accurate and inaccurate forecasts and the ratio of reasonably accurate to inaccurate forecasts from each WSFO for each period. A deterioration in performance was evident.

For WSFO IND, 23.5% of period one forecasts, 33.8% of period two forecasts, and 37.0% of period three forecasts were reasonably accurate. Additionally, 33.8%

of period one forecasts, 35.1% of period two forecasts, and 30.1% of period three forecasts were inaccurate. The ratios of reasonably accurate to inaccurate forecasts were 0.70 for period one, 0.96 for period two, and 1.23 for period three.

For WSFO WBC, 30.8% of period one forecasts, 27.1% of period two forecasts, and 25.9% of period three forecasts were reasonably accurate. Additionally, 38.5% of period one forecasts, 41.7% of period two forecasts, and 36.2% of period three forecasts were inaccurate. The ratios of reasonably accurate to inaccurate forecasts were 0.80 for period one, 0.65 for period two, and 0.71 for period three.

Finally, the analysis focused on the utility of updating cloud cover forecasts in the extended forecast. First, the three sequences of updates from WSFO WBC were examined. Each sequence was comprised of all the updates for one period of the extended forecast, ordered chronologically.

Each sequence was tested to see if the null hypothesis of random order of improvement/ no improvement could be rejected. This is a necessary precondition of using the binomial distribution for the purposes desired. A runs test yielded p-values well in excess of 0.10 in all three cases. There was no significant indication that any of the three sequences was not ordered randomly with regard to the improvement, or lack thereof, over original forecasts in the individual updates. Therefore, the binomial distribution was used to test the null hypothesis that the accuracy of the forecasts for each period was improved no more than 50% of the time by updating.

Out of the 51 updates of the day three forecast, 28 improved the accuracy (55%); 32 out of 58 updates of the day four forecast improved the accuracy (55%); and 36 out of 57 updates of the day five forecast improved the accuracy (63%). The respective p-values were 0.29, 0.26, and 0.03. The null hypothesis that updating the cloud cover forecast in the extended forecast improved the forecast no more than 50% of the time was rejected in the case of period three only.

4. DISCUSSION

Consider the differences in forecast methodology at the two offices. First, the forecasters at WSFO IND were aware they were making a forecast for purposes of a verification study, while forecasters at WSFO WBC usually were not considering the verification study when they made their forecasts. At first thought, it might seem this was an advantage for WSFO IND. However, WSFO IND forecasters had an added duty that involved extra time, thought, and some paperwork for the better part of a 2 year period. It is conceivable that this grew tiresome, which could have had a negative impact on the forecasts.

Second, forecasters at WSFO IND knew they were forecasting for a precise location. Forecasters at WSFO WBC were writing three separate extended forecasts, and were not specifically forecasting for the precise verification location, although they did write the product with the Washington D.C. metropolitan area in mind. This probably was an advantage for WSFO IND.

Third, all forecasts produced at WSFO IND were retained for general verification. Also, the set of forecasts for more independent days that was retained for the second verification was derived from that complete set. At WSFO WBC, some forecasts were eliminated prior to verification. These forecasts tended to be forecasts for days when precipitation was forecast (since it usually was this type of forecast for which no associated cloud cover forecast was made), and days when cloud cover was expected to change (since forecasts for those 24-h calendar days were such that one cloud cover category could not be ascribed). Since it has been shown there is no skill forecasting cloud cover for days when cloud cover changes considerably, elimination of such forecasts likely favored WSFO WBC.

Despite these differences, and the different manner in which they favored one office or the other, results from the two offices were reasonably similar to each other. Both offices showed skill in forecasting for the first two periods of the extended forecast. WSFO IND showed skill for the third period. Also for each period, the difference between the percentage of reasonably accurate forecasts from WSFO IND and WSFO WBC was not statistically significant. The same was true, for each period, in regard to the difference between the percentage of inaccurate forecasts from WSFO IND and WSFO WBC.

When the meteorological independence of the target days of the forecasts was increased, neither office showed skill for any period of the extended forecast. Again for each period, the difference between the percentage of reasonably accurate forecasts from WSFO IND and WSFO WBC was not statistically significant. The same was true for each period, in regard to the difference between the percentage of inaccurate forecasts from WSFO IND and WSFO WBC.

Noting the consistency in the results from the two forecast offices, the implication is that there is skill in extended cloud cover forecasts for the first two periods. Whether or not there is skill in the third period remains a question. Moreover, there is an indication that at least some of the skill comes from taking advantage of meteorological persistence. This conclusion is based on the fact that there was no skill in the forecasts for any period from either WSFO, when meteorological independence of the days was increased (when there likely was a change in weather occurring).

These conclusions do not necessarily lead to the recommendation that cloud cover forecasts should be avoided. The amateur astronomer who wants to know if they should plan several days in advance to travel a hundred miles or so to view some astronomical phenomenon, does not care if the skill in the forecast is due to meteorological persistence. The percentages of reasonably accurate forecasts (generally, almost half) and inaccurate forecasts (generally, about one fifth) indicate that extended cloud cover forecasts often give the user an indication of what the skies will be like. It is true however, that if a user is looking for an accurate forecast of a fairly large one-day change in cloud cover three to five days in advance, they may well be disappointed.

Regarding updated extended cloud cover forecasts, it might be that the next look at a period generally is not as helpful as the first look at a period. When forecasters at WSFO WBC made the afternoon extended forecast, the numerical model runs extended in time as far as 1200 UTC of period three. Basically, they were making a forecast for period three with guidance covering less than a third of this period. When update time came, the new guidance extended through the third period. Use of this new guidance allowed the forecasters to improve the ongoing period three forecasts significantly more than half the time. A look at new guidance for periods one and two (for which older guidance had been available) did not improve the ongoing forecasts significantly more than half the time. There are two caveats to this conclusion. The first caveat is that these results were not duplicated at the two WSFOs. Although the staff at WSFO IND does update its extended cloud cover forecasts when warranted, there were an insufficient number of updates to derive meaningful results. The second caveat is that the test based on the binomial distribution was not powerful enough given the number of WSFO WBC updates and the percentages for the first two periods.

Throughout the period of study, the period one and two forecasts were improved about 55% of the time. Statistically, these percentages are considered estimates of the true percentage of the time an update would improve an original forecast. The purpose of the statistical test is to see whether or not the estimates indicate that the true value would be greater than some pre-established value (in this case, 50%). Use of the binomial distribution in the case of the first two periods did not indicate that the 55% estimates for the first two periods were significantly greater than 50%. However, because of the lack of power, additional cases would be needed to establish either that the true rate of improvement was or was not greater than 50%.

5. SUMMARY

Cloud cover forecasts from the extended forecasts prepared at from the National Weather Service Forecast Offices for Indianapolis and Washington D.C. were collected from February 1990 through January 1992, and from January 1991 through July 1992 respectively. The forecasts were verified by using observations from the principle cities and chi-square analysis. Chi-square analysis was used to test, for each city and for each period (calendar day) of the extended, the null hypothesis that the forecasts were independent of the observations and therefore showed no skill. Results for WSFO IND were that the null hypothesis was rejected for all three periods of the extended forecast. Results for WSFO WBC were that the null hypothesis was rejected for the first two periods.

A subset of forecasts from each WSFO for each of the three periods of the extended was tested in the same manner. The subsets were comprised of forecasts for days that were more independent of each other than the original sets. They were created by retaining the forecasts for days in which there was a change in 24-h opaque cloud cover of at least 4.5 tenths. Results of chi-square analysis showed that the null hypothesis was not rejected for any period at either office.

Finally, updates to the full set of extended cloud cover forecasts for each period from WSFO WBC, only were tested to determine if the updates improved the original forecasts. The binomial distribution was used to test the null hypothesis that improvement occurred only half the time or less. Results of analysis based on the binomial distribution were that the null hypothesis was not rejected for the first two periods of the extended, but that it was rejected for the third.

ACKNOWLEDGMENTS

Thanks are extended to the management and staff at WSFO Indianapolis for graciously accepting the extra work in support of this study. Thanks also to the management and staff at WSFO Washington D.C., and especially to Steve Zubrick, the Science and Operations Officer.

REFERENCES

Panofsky, H.A. and G.W. Brier, 1968: *Some Applications of Statistics to Meteorology.* Pennsylvania State University, University Park, 224 pp.

National Weather Service, 1984: Zone and local forecasts. National Weather Service Operations Manual, Chapter 11, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 32-33.

Table 1. Contingency table for cloud cover observations and forecasts from WSFO IND (period 1, all days).

		Observed					
		clear	mostly clear	partly cloudy	mostly cloudy	cloudy	**total**
	clear	9	9	9	4	2	33
Forecast	mostly clear	17	26	24	5	6	78
	partly cloudy	16	38	48	27	18	147
	mostly cloudy	6	4	18	20	29	77
	cloudy	0	4	7	4	16	31
	total	48	81	106	60	71	366

Table 2. Contingency table for cloud cover observations and forecasts from WSFO IND (period 2, all days).

		Observed					
		clear	mostly clear	partly cloudy	mostly cloudy	cloudy	**total**
	clear	5	3	7	3	2	20
Forecast	mostly clear	12	22	21	8	4	67
	partly cloudy	26	38	53	19	23	159
	mostly cloudy	4	6	20	20	26	76
	cloudy	1	3	7	9	15	35
	total	48	72	108	59	70	357

Table 3. Contingency table for cloud cover observations and forecasts from WSFO IND (period 3, all days).

		Observed					
		clear	mostly clear	partly cloudy	mostly cloudy	cloudy	**total**
Forecast	clear	3	5	3	2	1	14
	mostly clear	14	20	18	8	9	69
	partly cloudy	20	37	52	26	22	157
	mostly cloudy	9	12	27	10	25	83
	cloudy	0	2	6	15	10	33
	total	46	76	106	61	67	356

Table 4. Contingency table for cloud cover observations and forecasts from WSFO WBC (period 1, all days).

		Observed					
		clear	mostly clear	partly cloudy	mostly cloudy	cloudy	**total**
Forecast	clear	6	6	5	1	1	19
	mostly clear	13	28	29	8	7	85
	partly cloudy	18	39	84	26	18	185
	mostly cloudy	1	1	9	10	15	36
	cloudy	0	0	4	2	5	11
	total	38	74	131	47	46	336

Table 5. Contingency table for cloud cover observations and forecasts from WSFO WBC (period 2, all days).

		Observed					
		clear	mostly clear	partly cloudy	mostly cloudy	cloudy	**total**
	clear	2	10	4	2	3	21
Forecast	mostly clear	7	24	30	4	4	69
	partly cloudy	24	35	89	30	23	201
	mostly cloudy	0	2	9	5	14	30
	cloudy	0	2	5	5	6	18
	total	33	73	137	46	50	339

Table 6. Contingency table for cloud cover observations and forecasts from WSFO WBC (period 3, all days).

		Observed					
		clear	mostly clear	partly cloudy	mostly cloudy	cloudy	**total**
	clear	1	11	14	2	3	31
Forecast	mostly clear	9	18	18	8	7	60
	partly cloudy	23	44	84	29	29	209
	mostly cloudy	0	3	12	7	7	29
	cloudy	0	3	6	4	8	21
	total	33	79	134	50	54	350

Table 7. One-day change in average opaque sky cover at WSFO IND and WSCMO DCA. Entries are number of days followed by percentage of the column total.

	WSFO IND	WSCMO DCA	COMBINED
<0.5	74 (18.4)	69 (12.2)	143 (14.8)
0.5-<1.0	43 (10.7)	75 (13.3)	118 (12.2)
1.0-<1.5	48 (12.0)	52 (9.2)	100 (10.3)
1.5-<2.0	34 (8.5)	62 (11.0)	96 (9.9)
2.0-<2.5	35 (8.7)	46 (8.1)	81 (8.4)
2.5-<3.0	18 (4.5)	48 (8.5)	66 (6.8)
3.0-<3.5	31 (7.7)	42 (7.4)	73 (7.5)
3.5-<4.0	20 (5.0)	38 (6.7)	58 (6.0)
4.0-<4.5	15 (3.7)	39 (6.9)	54 (5.6)
4.5-<5.0	16 (4.0)	21 (3.7)	37 (3.8)
5.0-<5.5	14 (3.5)	21 (3.7)	35 (3.6)
5.5-<6.0	12 (3.0)	22 (3.9)	34 (3.5)
6.0-<6.5	15 (3.7)	9 (1.6)	24 (2.5)
6.5-<7.0	5 (1.2)	5 (0.9)	10 (1.0)
7.0-<7.5	6 (1.5)	7 (1.2)	13 (1.3)
7.5-<8.0	7 (1.7)	5 (0.9)	12 (1.2)
8.0-10.0	10 (2.5)	4 (0.7)	14 (1.4)
Total	402	565	967

Table 8. Contingency table for cloud cover observations and forecasts from WSFO IND (period 1, more independent days).

		Observed			
		clear/ mostly clear	partly cloudy	mostly cloudy/ cloudy	**total**
Forecast	clear/ mostly clear	7	4	11	22
	partly cloudy	13	4	14	31
	mostly cloudy/ cloudy	5	5	5	15
	total	25	13	30	68

Table 9. Contingency table for cloud cover observations and forecasts from WSFO IND (period 2, more independent days).

		Observed			
		clear/ mostly clear	partly cloudy	mostly cloudy/ cloudy	**total**
Forecast	clear/ mostly clear	4	2	11	17
	partly cloudy	15	8	10	33
	mostly cloudy/ cloudy	5	6	13	24
	total	24	16	34	74

Table 10. Contingency table for cloud cover observations and forecasts from WSFO IND (period 3, more independent days).

		Observed			
		clear/ mostly clear	partly cloudy	mostly cloudy/ cloudy	**total**
Forecast	clear/ mostly clear	9	1	9	19
	partly cloudy	9	8	14	31
	mostly cloudy/ cloudy	6	7	10	23
	total	24	16	33	73

Table 11. Contingency table for cloud cover observations and forecasts from WSFO WBC (period 1, more independent days).

		Observed			
		clear/ mostly clear	partly cloudy	mostly cloudy/ cloudy	**total**
Forecast	clear/ mostly clear	4	3	5	12
	partly cloudy	16	8	10	34
	mostly cloudy/ cloudy	1	1	4	6
	total	21	12	19	52

Table 12. Contingency table for cloud cover observations and forecasts from WSFO WBC (period 2, more independent days).

Forecast \ Observed	clear/ mostly clear	partly cloudy	mostly cloudy/ cloudy	**total**
clear/ mostly clear	5	4	6	15
partly cloudy	15	4	7	26
mostly cloudy/ cloudy	2	1	4	7
total	22	9	17	48

Table 13. Contingency table for cloud cover observations and forecasts from WSFO WBC (period 3, more independent days).

Forecast \ Observed	clear/ mostly clear	partly cloudy	mostly cloudy/ cloudy	**total**
clear/ mostly clear	4	4	5	13
partly cloudy	10	8	12	30
mostly cloudy/ cloudy	4	4	7	15
total	18	16	24	58